

Rapid assessment and sample surveys: trade-offs in precision and cost

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Health policies in many developing countries are increasingly designed and evaluated by data collected using household surveys. This trend is closely associated with three factors: the increasing complexity of health systems, the increase in pressure for better accountability and improved health system management, and the continuing existence of poorly maintained vital statistics systems. But national household- or individual-level surveys are expensive. These factors have, unsurprisingly, coincided with an increase in the use of rapid survey methods. Although rapid methods have been used frequently, few studies have tested the quality of data obtained by them, and none have compared the cost of the rapid surveys with non-rapid surveys in a developing country context. This paper presents the trade-offs in cost and quality of information obtained from a rapid assessment survey in Ecuador.

The results from the rapid survey were compared with results obtained from a national survey conducted six months earlier. The objective was to see what alternative policies might be arrived at if the data from the rapid survey were used in place of the large survey. In addition, the relative costs of obtaining that information were measured. Results indicate that the majority of demographic and contraceptive use measures are similar between the two surveys. The rapid survey was three times as cost-efficient as the traditional survey, if relative bias is not taken into account. However, there appears to be selection bias in the choice of households, which distorts the probability of predicting contraceptive use by residence, and makes it appear that rural women are as likely to use contraception as their counterparts in urban Ecuador. This result has implications for the credibility of rapid surveys, and suggests that their use needs to be tailored for particular programmes and policies, and overseen with, at least, a modicum of statistical caution.

Introduction

Information from household surveys, and the research necessary to develop those surveys, are now integral parts of policy-making in the health care field. The impetus for this study arose from a perceived need to expand and improve the methods used to gather information for health policy and planning. The links between information gathering and policy design and implementation are often assumed, thus it behoves us as researchers to improve these methods of data collection and contribute to an improved policy process (Walt 1994). In many developing countries, where census data may be unreliable, vital statistics registers incomplete, and health or clinic data heavily biased towards those who have ready access to clinics, the information gathered from household surveys is essential for equitable distribution of health dollars, and for efficient planning and evaluation (Von Braun and Puertz 1993).

Many of the existing health status and health care utilization survey methods are expensive, complex and time-consuming, and over the past decade health managers and policy-makers have been calling for cheaper and quicker methods for collecting information (Anker 1991, 1993; Tanner and Vlassoff

1992). As a result, a range of new methods (so-called rapid assessment surveys), which use abbreviated sampling methods or which reduce the time taken to develop answers, have been developed recently and many are already being used. However, research evaluating these newer methods has been sparse and little is known about the precision and reliability of some of the more popular ones, such as the Expanded Programme of Immunization's (EPI) Cluster Sample Method. Even less is known about the cost-efficiency of these methods.

This study investigates the costs, in terms of dollars and precision, of a rapid survey method which was used to evaluate family planning acceptance in four provinces in Ecuador. The paper also shows how policies that contribute to the distribution of health services might be affected if different (i.e. lower quality) survey data were used to formulate those policies. An experimental field test of a common rapid assessment survey (RAS) method was undertaken to explore this question. The RAS was tested in four provinces of Ecuador. Results are presented from the RAS and compared with results from a large, traditional ('non-rapid') survey, called Encuesta Demografica de Salud Materna e Infantil (ENDEMAIN-94), which had been completed 6 months earlier.

Background literature

Over the past two decades the national survey has become the instrument of choice for demographic and health measurement in many developing countries. Cross-national survey programmes have been sponsored by international donor organizations, such as the United States Agency for International Development (USAID) and the United Nations Population Fund (UNFPA), and co-funded by national governments to produce statistics on fertility, infant mortality, maternal mortality, maternal and child health, and knowledge and use of family planning methods to space and limit births. Over 200 large surveys have been conducted in about 110 developing countries since the early 1970s. These have been mainly implemented through the following programmes: the World Fertility Survey program (WFS, 1974–84), Population Laboratories (POPLAB, 1974–83), the Contraceptive Prevalence Surveys (CPS, 1972–84) and the Demographic and Health Surveys (DHS, 1984–the present), and through the maternal and child health division of the Centers for Disease Prevention and Control. In more than 80 countries, two or more surveys are available for comparisons across time (for an overview of the current situation see Tsui and Hermalin 1993).

This has been a considerable effort and many national policies have undoubtedly benefited from the wealth of information generated by these surveys. However, reduced resources and anti-foreign-aid sentiment in several parliaments (notably the US Congress) means that ministries of health in developing countries are now, or in the near future, going to have to rely on their own, more limited resources for gathering information. Rapid surveys are being seen as one option for reducing the costs of survey material and making data available quickly for the purpose of policy design and evaluation.

Rapid surveys have been developed from an assortment of disciplines and needs. Development economics, rural development studies, anthropology, statistics, epidemiology and public health and nutrition are a few of the disciplines that have helped develop different types of rapid surveys, and thus, almost by definition, there is still considerable controversy about exactly what constitutes a rapid survey. But despite this heterogeneous ancestry, most authorities include five attributes that characterize a generic rapid survey. These are: low cost, quick feedback of results, short questionnaire, smaller sample size than would be expected, for example, under a traditional sample survey, and, increasingly, computerized data capture and analysis. Another generally agreed distinction within different types of rapid surveys is the qualitative/quantitative one. Many authors on this subject agree that the type of method chosen should only be dictated by the type of question asked. But despite this, a number of areas of rapid survey design remain cloudy. This paper does not seek to solve this problem of typology but instead it focuses on one type of quantitative rapid survey – a type based upon the EPI Cluster method, which was originally designed by researchers at WHO (WHO 1991) looking at opportunities to measure immunization coverage quickly and cheaply in numerous contexts (see also

Henderson and Sundaesan 1982; Lemeshow and Robinson 1985).

Tanner and Vlassoff reviewed the current status of rapid assessment surveys for health services using the community-based, epidemiologically-driven rapid survey methods that are generally designed to produce quantitative results (Tanner and Vlassoff 1992). They concluded that there were many potential benefits for the managerial and academic communities from the development of RAS, that money saved through these approaches might be spent on other aspects of service delivery, and that RAS might improve communication between levels of authority. Anker, in her review (Anker 1993), concluded that rapid methods would be used 'more often in the future', but warned that the current tendency of '[using these] techniques blindly – sometimes in situations totally unsuited to them' was potentially detrimental. This is particularly the case prior to validation studies, which have been largely absent up to now. She emphasizes that validation of all these methods is a priority for the policy research community. Tanner and Vlassoff also call for further validation studies as being a precursor to improving the state of the science of rapid survey methodology (Tanner and Vlassoff 1992). In terms of the trade-offs in cost and quality of data, an extensive review of the literature revealed no examples of analysis that included cost, other than the repeated reference to these rapid methods as 'cost-cutting and cheap' (e.g. Oyoo et al. 1991).

Other researchers and practitioners have assessed the development of the Rapid Assessment Procedures (RAP) and Rapid Rural Appraisal (RRA) methods that are now generally considered embedded in the main stream of evaluative research in developing countries (e.g. Chambers 1985; Scrimshaw and Hurtado 1988; Frierichs 1989; Manderson and Aaby 1992). But, again, there have been no analyses of the cost issues in this aspect of rapid survey development.¹

The existing criticisms of rapid surveys that have emerged from the more quantitative methods (of which the EPI method is probably the best known) have generally focused on the following aspects of the method: standardized questionnaires, subsamples for regional analysis, non-probability sampling methods (and the statistical consequences), sample size, sample frame and selection procedures, and the problems associated with the calculation of weights given that the selection procedure is non-probability (Kalton 1987; Anker et al. 1993; Bennett 1993). Among these problems the lack of a formal sampling frame may be one of the most important. Its lack may mean two things: first, that it is impossible to calculate the probabilities of selection, and second, and probably more important, is the possibility that there may be subgroups (the inaccessible and poorest) that simply cannot get into the sample, or have extremely low chances of being selected. This latter problem immediately introduces the possibility of selection bias, which is one of the main foci for this paper. The rapid method tested in Ecuador was based upon the EPI method, and thus contributes to this genre of rapid methods, as well as the relative cost of implementing a RAS for family planning evaluation.²

The study presented here was developed for several reasons.

- (1) There is a noted absence of evaluation of the rapid methods now in use in many parts of the health services sector. For example, despite over 4500 instances of reports at WHO in Geneva of EPI surveys being completed (by 1993), there are only a handful of validation studies (Anker 1993).
- (2) The expense of the population and health surveys, currently conducted with financial and technical support from various donors in developed countries, such as the demographic and health or the adult reproductive health surveys which are funded in large part by USAID, has generated calls for more rapid feedback of results and for cheaper surveys. A typical DHS-type survey now costs approximately one million dollars (pers. comm. Rod Knight, December 1996).
- (3) Rapid survey methods have not yet been applied to current contraceptive behaviour and its principle determinants, despite the evident interest in this area of human behaviour and health services. It was judged feasible and appropriate that the EPI Cluster Sampling Method should be applied for this purpose.
- (4) One feature increasingly referred to in the context of rapid assessment surveys is the use of computerized data entry, through Computer-Assisted Personal Interviews (CAPI), (e.g. see Frierichs and Tar 1989; Forster et al. 1991; Nicholls and Matchett 1992; Cushing and Loaiza 1994; Macintyre 1995). The intention of CAPI is to skip the expensive and time-consuming data-entry step, lower error rates through the use of range checks at point of data entry, and generally speed up the analytical stage of survey work. However, few studies have tested the use of computers in typically harsh and hot field conditions in developing countries, and no rapid surveys (with published results) have compared paper with computer data entry for response rates and data entry errors.³

Ecuador was selected as a good site to assess the feasibility and quality of results obtained from a RAS for three reasons. A national survey had been recently completed and its results could be used as a gold standard against which to test the RAS results. In addition, the contraceptive prevalence rate is reasonably high (48.3% in 1994) thus deviations from a gold standard would be relatively quickly identified. Finally, despite being a small country (population 12 000 000), Ecuador presents considerable variety both in terms of terrain and climate for testing the durability and robustness of the micro computers, and in terms of socio-demographic variables across the Sierra and coastal regions.

Methods and data

The larger survey, against which the rapid survey was tested, was ENDEMAIN-94. Data collection had been completed in 5 months in September 1994, about 6 months prior to the rapid survey field work. In ENDEMAIN 20 000 households had been contacted, and 13 582 women interviewed during this multi-stage cluster sample survey, which covered 95% of Ecuador – the Sierra and the coastal regions. Data from four provinces were subsampled from ENDEMAIN and are used

as the comparison ‘gold standard’ data set. The final data set of 1042 completed interviews used data from households in the same clusters, as well as the same provinces, as were subsequently selected for the rapid survey.

ENDEMAIN was implemented by the Ecuadorian research organization, Centro de Estudios de Poblacion y Paternidad Responsable (CEPAR). Technical support was provided by the Survey Unit of the Division of Reproductive Health within the CDC. The goals of ENDEMAIN were to generate national and sub-national (provincial) estimates of fertility, reproductive health and child health indicators, contraceptive behaviour and knowledge, and reproductive preferences of Ecuadorian women of reproductive age (15–49 years). The financial costs associated with survey preparation, data collection and analysis were also obtained from CEPAR.

The RAS was also implemented by CEPAR and the sample was selected in several stages, namely at the provincial, cluster and household levels. At the first stage, four provinces were randomly selected to give equal representation to the Sierra and the coastal regions (Cotopaxi and Imbabura in the Sierra region and Manabi and Esmeraldas at the coast). The second stage consisted of the random selection of 36 clusters from a list of all clusters in the four provinces.

A goal of any RAS, modeled on the EPI Method, is to reduce total costs by avoiding having to create a sampling frame.⁴ In order not to have to list the households for the sampling frame, and yet retain random sampling within each primary sampling unit (PSU) or cluster, the third stage sample selection (identifying households to contact) takes place in the field. The normal procedure under the EPI method is as follows: firstly, the geographical central point of the PSU is identified from the map. This is the starting point for the selection of households. Next, a random direction from this starting point is selected using a spinning object, such as an empty bottle or a pencil. From this central point one proceeds in the direction selected until the boundary of the sector is reached, as identified on the map.

During the pretest we ascertained that different starting point procedures needed to be established in rural and urban areas. This is because, while in urban areas one can be reasonably confident of finding households within reach of the central starting point of each PSU, in sparsely populated rural areas of Latin America there is no guarantee that the random direction (from the spun bottle) will provide households for inclusion in the survey. Households in Ecuador tend to be scattered across wide areas. Thus, the classic EPI survey design was modified for rural areas. This involved identifying starting points for the interviews prior to arrival at the rural sector by random selection from all possible starting points on the map of the sector. Each starting point was a population ‘dot’ (such as a farm, hamlet or small town) on the detailed census maps provided by the Ecuadorian Census office. From the previously identified points the team of interviewers moved towards the next closest point on the map, interviewing all households in between, including those off the roads.⁵

Once the household was selected, only one woman per

household was interviewed. This woman was randomly selected from a list of all women of reproductive age (15–49 years) in that household. A total of 1721 households were contacted and 1185 women interviewed. Of these 991 were interviewed in the same clusters as ENDEMAIN. These 991 compare with 1042 women from the large survey.

A short instrument was developed for the RAS using a subset of the questions that had been asked during ENDEMAIN. This was done for several reasons: first, to cover the same topics (using the same wording) across both surveys and thus to be able to compare the results and indicators developed; and second, to simplify training procedures. The questions used included all the household roster section, most of the family planning questions, basic background characteristics of the household and the woman, and all the questions related to the respondent's reproductive preferences and desired family size. The length of the RAS, which came to a total of 55 questions, was about a fifth of the length of ENDEMAIN's instrument.

Results

Table 1 shows the relative response rates of the two surveys. Out of 4092 households contacted, 2862 women were interviewed in ENDEMAIN. Out of 1721 households in the RAS, a total of 1188 women were interviewed.

Approximately one-third of the households in both surveys had no women eligible for interview, i.e. within the fertile age limits (15–49 years). Ninety percent of the households with at least one reproductive age woman completed an interview in the large survey, compared with 85% in the RAS; and just under 2% of all possible respondents refused an interview during the first survey, compared with nearly 3% refusing during the RAS.

Table 2 indicates that among the main measures of socio-demographic change and family planning use, the majority of

the variables are similar whether they are measured using ENDEMAIN or the RAS data. Mean age, marital status, the proportion reporting as head of the household, and all the contraceptive use indicators are not statistically significantly different from each other, comparing across data sources, when tested using chi-square tests. Figures 1 and 2 also demonstrate how the confidence intervals, as measured by each survey method, overlap for mean age of the population and the proportion of women interviewed who report they are currently using a method of family planning, thereby confirming that, statistically speaking, these results come from the same population. However, the education levels appear to differ significantly across survey method, as does the location variable indicating area of residence. The measure of whether there is indoor water in the house, or not, also differs significantly.

Contraceptive prevalence among married women aged 15–49 was estimated using both sets of data. The large survey produced an estimate of 47%, only marginally greater than the RAS figure of 45.8%. Thus, at the aggregate level (of four provinces) the RAS data, used in calculating this indicator of contraceptive use, produced almost identical results as ENDEMAIN.

Table 3 provides the observed values for the main variables of interest in their bivariate relationship to each other (i.e. contraceptive use by education levels and residence). These cross-tabulations demonstrate that the differences between high and low levels of education and contraceptive use are slightly less apparent using the rapid data compared with ENDEMAIN. However, the residential differentials look even closer comparing women in rural areas who use modern methods as measured by the rapid data, relative to the rural women (from the same clusters) who were selected under the sampling plan for ENDEMAIN. These relationships are tested further using a full model to predict contraceptive use, and the results are presented next.

Table 1. Survey results and response rates: ENDEMAIN-94 and the Rapid Assessment Survey

Survey method	ENDEMAIN-94 Four provinces	Rapid Assessment Survey
Households contacted	4092	1721
By residence:		
urban	1798	959
rural	2294	762
Individual results: completed interviews	2862	1188
No eligible woman for interview ¹	914	329
Refused	56	41
Other	260	163
Response rate ²	90%	85%
Refusal rate ³	1.8%	2.9%
Final sample used – women interviewed in the <i>same clusters</i>	1042	991

¹ No woman of reproductive age (15–49 years) living in the household.

² Response rate = number of interviews/total number of households reached containing eligible women (15–49 years) [e.g. (for ENDEMAIN) 2862/(4092–914) = 0.90].

³ Refusal rate = number of refusals/number of households where there was an eligible woman (15–49 years) [e.g. (for ENDEMAIN) 56/(4092–914) = 0.018].

Table 2. Summary statistics for ENDEMAIN-94 and rapid survey, standard errors (SE) corrected for clustering (i.e. adjusted with the design effect) and weighted

Variable	ENDEMAIN-94 n = 1042		Rapid Survey-95 n = 991		χ^2 results
	<i>Proportion</i>	<i>SE</i>	<i>Proportion</i>	<i>SE</i>	
Urban res.	0.39	0.03	0.6	0.09	***
Sierra region	0.48	0.48	0.52	0.58	
Age (mean)	28.54	0.42	27.63	0.69	
Work	0.42	0.08	0.54	0.06	***
Married	0.62	0.02	0.59	0.03	
Proportion HH	0.06	0.004	0.05	0.006	
Education:					
None	0.3	0.03	0.21	0.05	*
Primary	0.3	0.03	0.25	0.06	*
Secondary	0.23	0.04	0.27	0.04	**
Further	0.17	0.03	0.27	0.07	***
Water	0.38	0.11	0.57	0.2	***
Family planning:					
Ever use	0.62	0.03	0.65	0.02	
Current use	0.29	0.05	0.3	0.03	
Trad. method	0.07	0.02	0.1	0.05	

Significance level measuring whether there are statistically significant differences between the indicators of the rapid survey compared with the ENDEMAIN data: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.01$.

Urban Res. = urban residence at time of survey.

Work = proportion of women who say they worked in the past 12 months.

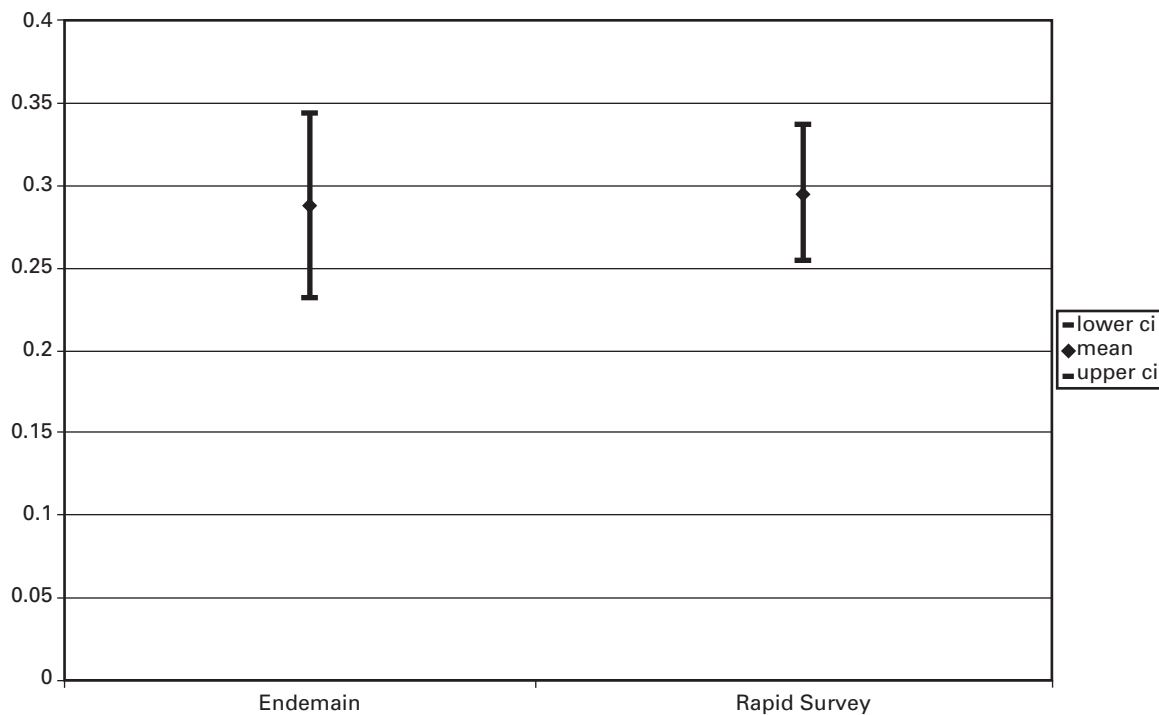
Married = currently married or in union.

Proportion HH = the proportion of respondents who report as head of household.

Water = domestic water source available inside the house.

Current use = currently using a modern method of family planning.

Trad. method = currently using a natural or traditional family planning method such as Billings, withdrawal or the rhythm method.

**Figure 1.** Confidence intervals – current use of family planning

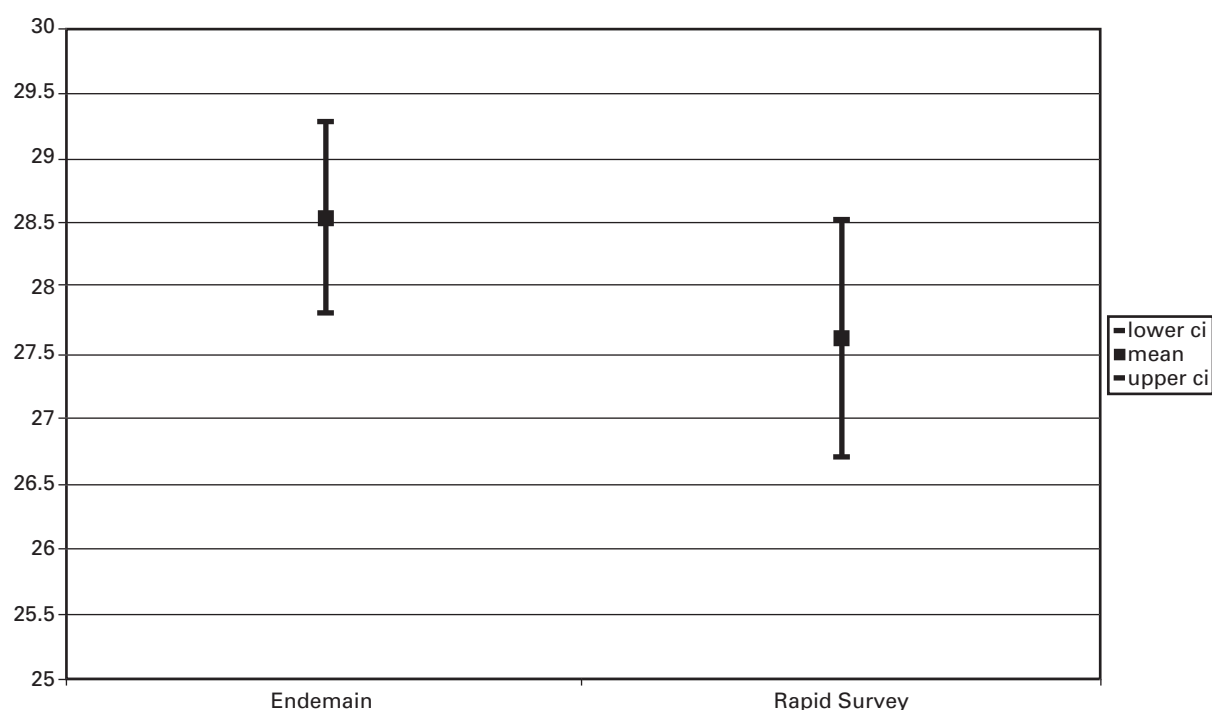


Figure 2. Confidence intervals – mean ages of respondents

Table 3. Proportions of respondents in ENDEMAIN and the rapid survey observed as contraceptors (or not) by education level and area of residence

Variable	ENDEMAIN-94 n = 1042	Rapid Survey n = 991
Contraceptive use:		
modern	27.3	27.1
traditional	7.9	6.7
none	64.9	66.2
Contraceptive use by education:		
No education –		
modern	22.9	23.7
traditional	6.7	7.4
none	70.4	68.9
Primary education –		
modern	27.7	29.5
traditional	5.9	4.4
none	66.5	66.1
Secondary education –		
modern	22.4	23.5
traditional	9.0	6.9
none	68.6	69.6
Further education –		
modern	37.6	32.2
traditional	11.4	8.1
none	51.0	59.8
Contraceptive use by residential area:		
Urban –		
modern	34.5	30.0
traditional	11.1	8.2
none	54.4	61.8
Rural –		
modern	20.5	24.6
traditional	4.8	6.2
none	74.7	69.2

Multivariate models

The differences detected at the univariate level between the two surveys were also tested using multinomial regression models of contraceptive choice. Regression models are useful

for policy relevant research as they allow for the isolation of the impact of various variables, by controlling for the confounding effects of the other independent variables on the dependent variable. The *multinomial* method was appropriate because the dependent variable of choice (contraceptive

mix) has three categories. These are whether the respondent reports current use of a modern method of contraception, or she is using a traditional method, or no method at all.

There were two reasons for selecting this model of contraceptive choice to test the RAS method. Firstly, policy-makers in Ecuador (Ministry of Health) have expressed an interest in the choice of method selected by women for spacing of births (CEPAR, 1995), and non-governmental organizations, such as the IPPF affiliates (APROFE and CEMOPLAF), have voiced concern that large numbers of women seem to be demonstrating a need for contraception, and their lack of access to modern methods, through their high reliance on traditional methods of family planning. The predictor variables for this model of contraceptive mix are selected to indicate which women, on average, have high probabilities of using traditional or modern methods, vs. no method. Policy-makers might be particularly interested in how the predicted probabilities are affected, in terms of their significance and magnitude, by the variables of urban vs. rural residence, age, education levels and marital status. The second reason for testing the data using this multinomial regression model is to subject the different data collection methods to more in-depth analysis; in particular, to the robustness of the predicted probabilities from each model, and assess how they compare from a policy perspective. In other words, I ask: what if the rapid survey method was being used to establish policies in Ecuador? What would these predicted probabilities tell policy-makers about current contraceptive behaviour, and how would these predictions differ from the gold standard or traditional survey – ENDEMAIN-94?

The multinomial logistic model, which expresses the probability that individual i chooses method j , traditional or modern contraception (relative to no method), can be expressed as:

$$P_{ij} = \frac{\exp(X_i \beta_j)}{\sum \exp(X_i \beta_k)}$$

where X_i = vector of individual characteristics of all women i ; β = parameter vector for individual characteristics; j = number of alternative methods ($= 1, 2 \dots k$).

The independent variables used in this model are: age, education level, marital status, socioeconomic and residence indicators.

Multinomial models were run using both the ENDEMAIN data and the rapid survey data. Because of the non-linearity of the model the coefficients are somewhat hard to interpret. One further step – the creation of the average probabilities predicted by the model – generates more readily interpretable findings that are extremely useful for policy-makers. The predicted probabilities represent the *summation* and *average* of the individual probabilities for women with each characteristic of interest, while controlling for other variables included in the model. The answers can inform policy-makers as to the necessary level of resources needed in particular geographic areas, or whether existing education campaigns are being directed at the correct age groups. By simulating

alternative positions (no education relative to completed primary, for example), it is possible to read from the data the future impact of programmes, as well as the current prevailing situation.

Results from the multinomial logistic estimation are presented in Tables 4–6 as predicted probabilities. These simulated predicted probabilities, as presented in Tables 5 and 6, are compared with the overall probabilities in Table 4.

Findings presented in Table 4 indicate that ENDEMAIN and the rapid survey produce identical overall probabilities for the use of each of the contraceptive choices, controlling for a number of important variables. For example, on average a woman has a probability of 0.27 of using a modern method of contraception, *ceteris paribus*, whether the model uses either ENDEMAIN or the rapid survey data.

Education is usually regarded as a policy-manipulable variable. This means governments and non-governmental agencies can influence the accessibility and availability of this social service through the release, the quantity, and the distribution of resources. A large literature (in both the public health and the social-demographic disciplines) supports the notion that female education is an important factor in fertility reduction (Cochran 1988). Thus, policy-makers often seek information on the relationship between education and contraceptive use. Table 5 presents simulations of the impact of different levels of education on different choices of contraception. The results show that women raise the average probability of their using modern methods of contraception from 0.22 to 0.28, if the education level increases from no education to completed secondary school. There is no significant difference in this simulation between the rapid and ENDEMAIN data, which leads to the conclusion that it would make no difference to the final design of policy if policy-makers were presented with information from the rapid survey, compared with ENDEMAIN. The policy of encouraging girls to complete secondary education is still highly advantageous in terms of its impact on contraceptive use.

Table 6, on the other hand, illustrates the different impacts that the area of residence measure (urban or rural) has on the average probability of contraceptive use. The respondents in the rapid survey show almost no differences in the predicted probabilities of contraceptive use, whether they live in urban or rural areas, i.e. both rural and urban women have an average probability of 0.27 of using modern methods. Contrast

Table 4. Average predicted probabilities that women used modern, traditional or no method of family planning. Data from ENDEMAIN ($n = 1042$) and Rapid Survey ($n = 991$). All women reproductive age (15–49 years).

Method of contraception	ENDEMAIN ($n = 1042$)	Rapid Survey ($n = 991$)
Modern	0.27	0.27
Traditional	0.07	0.07
None	0.65	0.66

Table 5. Simulated impact of increase in education levels on the probability of use of contraception, using ENDEMAIN (n = 1042) and Rapid Survey (n = 991). All women reproductive age (15–49 years).

Method of contraception	ENDEMAIN (n = 1042) Education variable				Rapid Survey (n = 991) Education variable			
	None	Primary	Secondary	Further	None	Primary	Secondary	Further
Modern	0.22	0.27	0.28	0.33	0.23	0.27	0.28	0.31
Traditional	0.08	0.06	0.1	0.08	0.06	0.04	0.09	0.09
None	0.7	0.66	0.61	0.58	0.71	0.69	0.62	0.61

Table 6. Simulated impact of control variable for residence (urban/rural) on use of contraceptives using ENDEMAIN (n = 1042) and Rapid Survey (n = 991). All women reproductive age (15–49 years).

Method of contraception	ENDEMAIN (n = 1042)		Rapid Survey (n = 991)	
	Urban	Rural	Urban	Rural
Modern	0.29	0.22	0.27	0.27
Traditional	0.1	0.05	0.07	0.06
None	0.6	0.72	0.65	0.67

this to ENDEMAIN's respondents (in the four provinces that were revisited in the rapid study) who demonstrate a much lower probability of using modern or traditional methods, and a higher probability of non-use, if they are resident in rural areas.

This is a significant result, since policy-makers, who might rely upon this type of rapid survey method, would conclude that rural and urban women, surveyed in the four provinces of Ecuador, demonstrate similar contraceptive behaviour. This is not likely to be the true situation. In Ecuador's recent national surveys the differential for contraceptive use between urban and rural areas, has been marked. Policies based upon this erroneous result may lead to differential distribution of financial or human resources from policies that use ENDEMAIN's results. This could effect the distribution of contraceptives or human resources that, subsequently, could have a detrimental effect on access to contraceptives in rural Ecuador. In conclusion, this lack of difference between the urban and rural women suggests a problem in the design of the rapid survey and particularly in how the households were selected for interview at the second stage. This is discussed in the final section.

Cost-efficiency results

The relative cost-efficiency of the rapid survey was estimated using a sensitivity analysis approach, and estimating low, middle and high levels of cost-efficiency based on different values of the components of Kish's cost-efficiency formula (Kish 1965). This formula only looks at the efficiency in terms of the variance, and does not account for bias which may be present in both sources of data. The question of bias is addressed through the analysis of the multinomial results in

the discussion section. Thus, it should be remembered that Kish's formula is based upon assumptions of random sampling that, theoretically, are 'bias-free'.⁶ However, it is the best, and one of the few measures of cost-efficiency, even though it has rarely been used in applied fieldwork:

$$\frac{Cost_{v1} * Var_{v1}}{Cost_{v2} * Var_{v2}}$$

where v is an element or variable, and $v1$ (in the numerator) represents data from ENDEMAIN, while $v2$ (in the denominator) represents data from the rapid survey.

This formula can be used to demonstrate the trade-offs between cost and quality of data and produces a relatively straightforward ratio to interpret. A ratio of greater than one suggests that the RAS was cost-efficient relative to the ENDEMAIN, while less than one gives the advantage to ENDEMAIN. Here, the quality of data was measured using variance (corrected for clustering effects in each survey) of an important measure of interest. The cost of collecting that element of data was estimated by assuming a survey instrument can be divided into equal parts, each part representing a question asked and attaching a basic average cost to this element.

Kish recommends the use of this cost-efficiency formula to derive estimates of the 'relative advantage of sampling designs' (Kish 1965, p. 266). It is used here to ask what are the trade-offs in cost between ENDEMAIN and the rapid survey, when the variances of a measure of interest are held constant. To be able to apply Kish's formula for estimating cost-efficiency, two main pieces of information are needed: the first is an estimate of 'cost per element' or 'cost per variable'. The second is the variance of a measure of interest.

ENDEMAIN cost a total of US\$232 448 to field and the Rapid Survey cost US\$6860. These figures, referred to henceforth as field costs, represent all costs incurred by CEPAR, to prepare and conduct the survey, to enter and check the data, and to produce preliminary results. These include both fixed and variable costs: for example, supervisory and interviewer salaries, insurance, per diems, transport, map preparation, questionnaire preparation and printing, computer hardware and software for data entry, training, pretesting costs, office administration costs in Quito, and other material costs such as protective packaging for the computers. However, the field costs do not include consultant and technical assistance fees,

which often make up more than half the total costs of fielding a national survey in a developing country. The field costs also do not include overhead costs for an assisting agency, nor the costs of producing and disseminating the final results.

To calculate a meaningful cost per variable for each survey, two main factors need controlling: the length of the questionnaire and the number of provinces covered during each survey.⁷ The length can be approximated by the number of questions asked: 254 in ENDEMAIN and 55 in the RAS. The total field costs for the two surveys are divided by these numbers to give the results of US\$919 and US\$124 costs per question in the ENDEMAIN and RAS surveys, respectively. To distinguish between what ENDEMAIN cost for the full national survey, and a simulation of what it would have cost (the partial cost) if it had been conducted in only four provinces, the partial cost of ENDEMAIN was calculated by taking the cost per province (there were 21 provinces in ENDEMAIN, compared with four in the RAS) and multiplying by four. This gives a comparable figure for estimating what a partial ENDEMAIN would cost if it were only conducted in four provinces. This figure was then divided by the measure of the length of the questionnaire (254) to give an equivalent cost per element for those four provinces or partial ENDEMAIN.

To establish sensitivity bounds around the cost-efficiency results, the final estimate was surrounded by a 20% upper and lower bound. This serves to present the worst and best case scenarios for these cost-efficiency ratios. The figure of 20% is deliberately large. It is probably realistic to suggest that the rapid survey's or ENDEMAIN's budgets may be inflated or deflated by as much as this figure suggests, but it is unlikely to exceed a variability of 20%.

Table 7 reports that each question, asked of all respondents, cost between US\$735 and US\$1103 in the full ENDEMAIN, between US\$186 and US\$268 in a partial ENDEMAIN and between US\$99 and US\$150 for the RAS. These figures represent an approximation of a 'cost per element' of a survey.

The variance of a dependent variable was used to measure the precision of an 'element'. The variable used in this analysis is whether a woman reports that she has ever used a modern method of contraception ('ever use'). This was one of the primary measures of interest in both surveys.⁸ Thus Var_{v1} (0.00097) is the variance of the dichotomous variable – ever use of contraception – as measured by ENDEMAIN, while Var_{v2} (0.0006) is the variance from RAS.

Table 7. Estimated costs by survey method, per question asked – low, medium, high; equivalent to cost per variable (US\$). Cost estimates based on field costs only.

	ENDEMAIN Full	ENDEMAIN Partial – 4 prov.	Rapid Survey
Cost per variable:			
Low	\$735	\$186	\$99
Midpoint	\$919	\$232	\$124
High	\$1103	\$268	\$150

Table 8. Cost-efficiency statistics: the relative cost-efficiency of measuring contraceptive use among women in Ecuador. Comparisons between the costs per question for all of ENDEMAIN (Full) and Rapid Survey (RAS), and between a partial estimate for a reduced ENDEMAIN (Partial) and RAS.

Survey method ratio	Low/High	Midpoint	High/Low
Full ENDEMAIN/RAS	2.64	3.95	5.95
Partial ENDEMAIN/RAS	1.99	3.01	4.36

Table 8 presents the cost-efficiency results. A ratio greater than 1.0 means that a rapid assessment survey is efficient relative to ENDEMAIN. The midpoints suggest that the RAS was between three and four times as cost-efficient, controlling for sample size, provinces covered and length of questionnaire. The range of the ratio in the 'ever use' results suggest that if the costs of the rapid survey have been overestimated, or the ENDEMAIN costs underestimated, then a ratio closer to 4.35 is more realistic. Conversely, if the costs of the rapid survey have been underestimated, and ENDEMAIN overestimated, the ratio dips to below 2.0.

Discussion

Using this method of establishing trade-offs in precision and cost between two surveys, the RAS appears to be about three times as cost-efficient as ENDEMAIN, controlling for sample size, length of questionnaire and area covered (four provinces). As this is the first direct cost evaluation of an RAS compared with a traditional household survey, it is not possible to assess how good or bad this cost-efficiency result may be in the larger scheme of things. Further evidence will be needed, from other survey comparisons, before judging the efficiency of this rapid survey.

But while the basic fiscal advantages of an RAS are relatively clear, the issue of quality of data produced is more complex. There appears to be selection bias present in the design of the rapid survey, which is only readily identifiable when the data are disaggregated, and especially when the data are fitted to basic models for the purpose of explaining characteristics of, in this case, contraceptive users. At the aggregate level the results of the rapid survey were very close to those of the traditional household survey. Policy-makers who wish to gain a quick picture of contraceptive prevalence, method mix and mean socio-demographic factors in a relatively small population can be advised to use this type of survey. However, the results of the differential between contraceptive use in urban and rural women in Ecuador suggests extreme caution be used when designing a rapid survey. I next consider three main reasons why the results (in Tables 4–6) seem to show evidence of the strong differences in the ENDEMAIN survey data compared with the RAS data. I also discuss the possible causes of the selection bias.

Firstly, these results may reflect a true changing picture of contraceptive use in Ecuador. In other words, in the intervening period of six months from the end of ENDEMAIN to the initiation of the RAS, Ecuadorian couples increased their

contraceptive use in rural areas by an amount such that their average probabilities of using a modern method equalled those of their urban counterparts. This is highly unlikely. Secondly, by chance we selected rural areas where women have a high rate of contraceptive use. However, since the final analysis used data from the *same* clusters, it is reasonable to dismiss this explanation also.

The third explanation considers the design of the sample, particularly in rural areas, and suggests that selection bias is present as a direct consequence of the way in which the rapid survey selected households for interview. Firstly, it is useful to consider what is meant by 'residential location' and how we use it in our models. 'Residential location' is a dichotomous variable describing whether a household is in an urban or rural area. It is a proximate determinant in this study (as in many others) of access to family planning information and outlets for the methods themselves. Women in urban areas are more likely to live closer to a distribution point of service – a government or non-governmental dispensary, health centre or hospital – and hence have better access to family planning. Urban households are also considered more likely to be users of contraception due to modernizing influences found in towns. For example, in the context of salaried jobs, increased education levels and general standards of living, couples are more likely to want to have a smaller family, and thus increase their use of contraception.

Another legitimate way of thinking about access to contraceptives is through the physical presence and quality of roads, and the proximity of households to roads. It is possible that through the selection procedures used in the RAS to choose households for interview, we selected women who live closer to roads. As described above, in drawing the sample for the rural areas we first selected a random starting point (on the map) and then proceeded along the road or path to the next closest point (again on the map). Although the supervisors were instructed to include all households within reach, necessarily this often meant that the interviewers contacted households that were less remote and closer at hand, since we only had a single day to complete each census sector, and this often included several hours of travelling time to reach the selected starting point. In other words, we *increased* the probability of interviewing the rural women who had better access to services by their very proximity to roads. This procedure is, I believe, the main cause of the selection bias in the selection of rural interviewees in the rapid survey, compared with ENDEMAIN. It is worth pointing out that ENDEMAIN probably also contains a measure of selection bias in the same area, since it is true that for nearly all surveys the more remote sections of a community are, by definition of their remoteness, more likely to be missed. Thus, this situation in the rapid survey is simply a more extreme case of bias that is probably present in all surveys.

What is the future for the RAS? Firstly, it appears that the rapid survey conducted in Ecuador was cost-efficient. Secondly, cost-efficiency, using a single variable and using its variance calculated on the basis of the entire sample, is only one measure of the quality and cost of data. Clearly, the problem of bias and the poor results, as a consequence, at the

disaggregated level of residence, is an obstacle for policy-makers and those within the research community who wish to use recent, good quality data for establishing health service priorities in developing countries.

Various options are open to those who wish to pursue rapid surveys for doing prevalence studies. The first option may be to use a complete sampling frame in rural areas to try to ensure that the interviewers reach the most remote communities and households. This would, by definition, cost more than the RAS tested in Ecuador, but would reduce the likelihood of selection bias. The second option involves further adaptation of the rapid survey sample-selection procedures. Researchers have been suggesting, for some years now, a feasible and practical method of sampling whereby the map of the selected sector is first divided into quadrants. These are then subsampled and all households in those quadrants are selected for interview (for a description of this method see Turner et al. 1996). A third option could be further use being made of the method of piggy-backing rapid surveys on top of traditional surveys, using the earlier sampling frames. Even though they may be out of date, they may still be better than nothing. This option would, of course, depend heavily on the quality of the map work and sample preparation done in the larger surveys, which, despite care and training, usually include some selection bias themselves. Its success would also depend on migration rates in the country of focus. Other options should also include further development and experimentation with the design and flexibility of rapid surveys.

Rapid surveys will surely continue to be used, and there has been no lessening of this trend in international health programmes despite questions of the validity and reliability of the results. The results here demonstrate, for the first time, these surveys' potential advantage in terms of general cost-efficiency. But this is balanced by a disadvantage in the selection of households in rural areas. Which options are selected, and in what contexts, will depend on future resource allocation levels as well as the imaginations of funding organizations, individual researchers and national or regional policy-makers who, in concert, may help develop a new generation of rapid survey designs that builds upon a rich and complex past.

Endnotes

¹ It is worth noting that 'rapid surveys' are not alone in this dearth of measurement of their costs and quality of data. According to Groves (1989) this is a seriously lacking element in all survey research.

² The EPI Cluster Method was designed to assess the coverage rates for immunization, and thus any deviation away from its original purpose may not be justified nor theoretically sound. However, given that so many other health problems (such as diarrhoea and ARI) are now being evaluated using this method, it was thought by a number of authorities to be feasible and worthwhile to test this sampling procedure for contraceptive prevalence surveys.

³ For half of the respondents in the rapid survey, a computer was used for data entry; paper and pencil was used for the second half. Results from this part of the study are not presented here but are available on request to the author, as well as in Macintyre (1997).

⁴ This imitates the sampling system used under the EPI method, as it short cuts the stage of creating a sampling frame at the

third stage, which is often a time-consuming, expensive operation, and is often poorly conducted in difficult field conditions.

⁵ This modification is described in detail elsewhere (Macintyre 1997).

⁶ It is worth noting that if bias in the RAS is measured as the mean squared deviation between the ENDEMAIN (the gold standard) and the RAS means, and subsequently included in the denominator of the Kish formula, RAS is no longer cost-efficient. However, this is partly because of the assumption that bias in the ENDEMAIN survey is zero. This assumption is obviously wrong. Further work needs to be done to estimate the level of bias in surveys based on random or quasi-random sample selection procedures.

⁷ This process took several stages and has been simplified here. The author would be happy to supply further details for those interested.

⁸ Although only the results from 'Ever Use' of contraception are presented here, other cost-efficiency evaluations were done using the variance of mean age of respondent. Similar results were obtained thus only one is presented here (Macintyre 1997).

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